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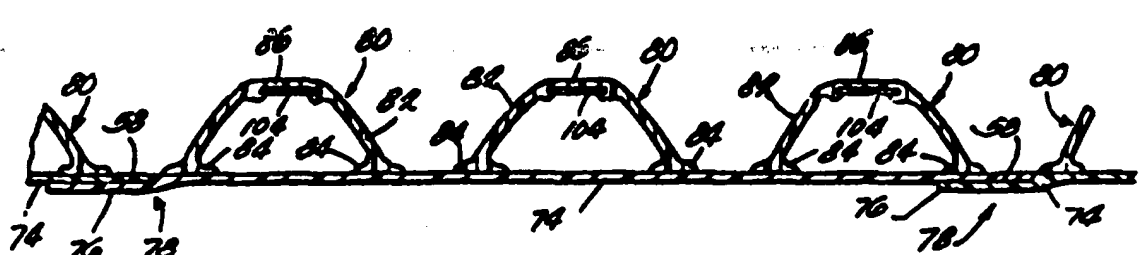
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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶: B62D 29/04	A1	(11) International Publication Number: WO 96/29233 (43) International Publication Date: 26 September 1996 (26.09.96)
(21) International Application Number: PCT/US96/03898 (22) International Filing Date: 22 March 1996 (22.03.96) (30) Priority Data: 08/409,183 23 March 1995 (23.03.95) US (71) Applicant: STOUGHTON COMPOSITES, INC. [US/US]; 302 23rd Street, Brodhead, WI 53520 (US). (72) Inventors: SJOSTEDT, Robbie, J.; 1544 Blue Heron Way, Oregon, WI 53575 (US). GROTE, Philip, B.; 915 Morning Sun Drive, Encinitas, CA 92024 (US). (74) Agent: KELLEY, Timothy, M.; Michael, Best & Friedrich, 100 East Wisconsin Avenue, Milwaukee, WI 53202 (US).		(81) Designated States: AL, AM, AU, BB, BG, BR, CA, CN, CZ, EE, FI, GE, HU, IS, JP, KG, KP, KR, LK, LR, LT, LV, MD, MG, MK, MN, MX, NO, NZ, PL, RO, SG, SI, SK, TR, TT, UA, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(54) Title: VEHICLE BODY INCLUDING LEAKPROOF DAMAGE-RESISTANT NONMETALLIC WALLS  (57) Abstract <p>A vehicle body (10), for a truck, a trailer, an intermodal container, or the like, has a lightweight, leakproof, damage-resistant, and corrosion-resistant wall construction. The wall construction includes a sheet-like panel (74) reinforced with vertical stiffeners (80). The panel (74) and the stiffeners (80) are made of nonmetallic material and the stiffeners (80) are adhesively bonded to the panel (74). The stiffeners (80) each include an outwardly facing surface (90) having a generally parabolic shape.</p>		

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VEHICLE BODY INCLUDING LEAKPROOF
DAMAGE-RESISTANT NONMETALIC WALLS

BACKGROUND OF THE INVENTION

5

Field of the Invention

The invention relates generally to vehicle bodies such as trailer and truck bodies, intermodal
10 containers, and the like, and more particularly to wall constructions which are employed in those vehicle bodies.

Reference to Prior Art

Vehicle bodies, such as intermodal containers and
15 trailer bodies, having aluminum wall constructions are well known. In one such construction, overlapping aluminum skins are riveted to one another to form side walls, and hat-shaped aluminum posts are riveted to the exterior surfaces (or interior surfaces) of the side
20 walls to provide structural support for the aluminum skins. That wall construction provides a thin wall cross-section which is important in maximizing interior cargo carrying space and which is generally structurally sound.

25 However, aluminum wall constructions are subject to some disadvantages. In particular, vehicle bodies made substantially entirely of metal are inherently heavy. Also, metal fasteners used in aluminum wall constructions can corrode or be subject to fatigue
30 failure and loosening. Additionally, fastener holes and seams between wall skins form potential leak paths that provide sites for the penetration of water or other undesirable materials into the interior of the vehicle body.

35 A further disadvantage associated with prior art wall constructions having exposed posts is their susceptibility to damage resulting from catching the squared posts on obstructions. Such damage is potentially severe and is often costly and time

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consuming to repair. For example, in storage lots and shipyards trailers and containers are often parked in very close proximity (i.e., within a couple of feet or less) to one another to save space. Unless care is taken when withdrawing a vehicle body from its parking spot, the side posts of the vehicle body can contact and catch on the corner of an adjacent vehicle body. This can cause the side posts to be ripped from the wall skins or the wall skins to be punctured.

10

SUMMARY OF THE INVENTION

The invention provides a vehicle body having an improved lightweight, weathertight and damage resistant wall construction. The improved wall is made of non-metallic, corrosion resistant material including fiber-reinforced plastic composite material, and the components of the wall are adhesively bonded together so that leak paths presented by fastener holes and wall skin seams are eliminated. Additionally, posts or stiffeners used to reinforce the walls are configured to reduce or eliminate damage to the wall in the event the stiffener is contacted or struck by an object, such as another vehicle body, for example.

More particularly, the invention provides a vehicle body such as an intermodal cargo container, a trailer or truck body, or the like, including front, top, bottom and side walls arranged in a box-like structure to define a cargo receiving interior space. The wall thicknesses of the vehicle body are preferably minimized to maximize interior cargo space, and the side walls are preferably made of a thin side panel formed by overlapping or abutting sheet-like wall skins. The wall skins are preferably made of fiber reinforced plastic composite material and are adhesively bonded to one another to interconnect the skins and to seal the seams between adjacent skins. The composite material used to make the wall skins is

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capable of supporting the shear loads encountered by the walls during a life of rigorous service.

To reinforce the side panel of each wall against compressive and tensile loads exerted on the wall during normal use of the vehicle body, side posts or stiffeners are provided. The stiffeners are made of non-metallic material such as a fiber reinforced plastic composite material and are adhesively bonded over the wall skins to eliminate fasteners. The substitution of adhesive bonds for fasteners avoids leak and corrosion problems associated with fasteners. Also, in one embodiment, the adhesive bonds are stronger than the non-metallic material used to make the stiffeners so that if a stiffener, such as a side wall stiffener for example, does catch on an object, the stiffener will fail before the adhesive bonds. This minimizes damage to the side wall.

In one embodiment, stiffeners used on the side walls each include a non-metallic rib member that is adhesively bonded to one of the side skins. The material used to make the rib members is a thermoplastic polymer material that is capable of elastically deforming in the event that it contacts or catches on something. To reduce the possibility that the rib member will indeed catch on anything, its outer surface has arcuate portions and is preferably generally parabolically-shaped in one embodiment. This stiffener, due to its design, is elastically deformable and is more likely to slide out of engagement with any obstruction than is the squared configuration of prior art side posts. The stiffener also includes a reinforcing member or insert mounted on the rib member. The reinforcing member is intended to stiffen the rib member and is preferably made of a fiber-reinforced plastic composite material.

In another arrangement, the stiffeners can be integrally formed of fiber-reinforced plastic composite material. In that arrangement the stiffener is

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preferably reinforced by thickening the cross-section of its crown and/or by using higher strength filamentary material (such as graphite in the place of fiberglass for example) capable of supporting loads to which the stiffeners may be subjected.

Various other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a vehicle body embodying the invention.

Fig. 2 is a reduced bottom plan view of the vehicle body illustrated in Fig. 1.

Fig. 3 is an enlarged cross-sectional view taken along line 3-3 in Fig. 2.

Fig. 4 is an enlarged cross-sectional view taken along line 4-4 in Fig. 1 and illustrating a side wall section including a first stiffener design.

Fig. 5 is a view similar to Fig. 4 and illustrates a side wall section in accordance with a second embodiment of the invention.

Fig. 6 is an enlarged view of part of the side wall section illustrated in Fig. 5.

Fig. 7 is a partial cross-sectional view depicting assembly of the stiffeners illustrated in Figs. 5 and 6.

Fig. 8 is view similar to Fig. 6 and illustrates a modified version of the stiffener shown in Fig. 6.

Fig. 9 is a view similar to Fig. 6 and illustrates a second alternative stiffener design shown positioned over a panel joint.

Fig. 10 is an enlarged cross-sectional view taken along line 10-10 in Fig. 1 and shows half-sections of two alternative front wall stiffener designs.

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Fig. 11 is an enlarged cross-sectional view taken along line 11-11 in Fig. 1 and shows half-sections of two alternative roof bow designs.

Before one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DESCRIPTION OF PREFERRED EMBODIMENTS

Illustrated in Fig. 1 is a freight hauling vehicle body 10 embodying the invention. While the vehicle body 10 can be integrated into a variety of freight hauling vehicles, such as to serve as a rail car body, a trailer or truck body, or a freight shipping container, in the illustrated embodiment the vehicle body 10 is an intermodal shipping container. More particularly, the container 10 illustrated in the drawings is an International Standards Organization (ISO) dry van container having a length of about forty feet.

As shown in Fig. 1, the container 10 comprises a frame 12. The frame 12 includes a rectangular front frame structure or stacking frame 14 having a pair of vertical front corner posts 16 interconnected by an upper crossmember 18 and a lower crossmember 20. Upper and lower lock-receiving front corner connectors or fittings 22 and 24, respectively, are provided at the four corners of the front stacking frame 14.

The frame 12 also includes a rectangular rear stacking frame 26 on which is mounted a set of doors (not shown) to access the interior of the container 10.

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The rear stacking frame 26 includes a pair of vertical rear corner posts 28 (only one of which is shown) interconnected by an upper crossmember 30 and (Fig. 2) a lower crossmember 32. Upper and lower lock-receiving rear connectors or fittings 34 and 36, respectively, are provided at the four corners of the rear stacking frame 30.

The upper fittings 22 and 34 and the lower fittings 24 and 36 are used to interconnect the container 10 with other containers (not shown) or with a support surface such as a ship deck, a railcar bed, or a trailer chassis, in a manner known to those skilled in the art. In the illustrated arrangement, the fittings 22, 24, 34 and 36 are standard intermodal fittings capable of receiving a locking device such as is disclosed in U.S. Patent No. 4,626,155 issued December 2, 1986 to Hlinsky et al., for example.

The frame 12 also includes (Fig. 1) a pair of upper rails 38 and (Fig. 2) a pair of lower rails 40 that all extend between the front and rear stacking frames 14 and 26. As shown in Fig. 3, each of the upper rails 38 includes an inwardly directed flange 42 and an inwardly facing surface 44 with a recessed surface portion 45. As also shown in Fig. 3, each of the lower rails 40 is generally Z-shaped and includes upper and lower flanges 46 and 48.

While the foregoing frame components can be made of metallic materials, in a preferred embodiment all of those components, with the exception of the fittings 22, 24, 34 and 36, are made of fiber-reinforced plastic material and are preferably formed via pultrusion. Pultrusion apparatus and methods known in the art are disclosed in U.S. Patent No. 3,769,127 issued October 30, 1973 to Goldsworthy et. al., and in U.S. Patent No. 3,556,888 issued January 19, 1971, and U.S. Patent No. 2,871,911 issued February 3, 1959, both to Goldsworthy, all of which are incorporated herein by reference. Briefly, the pultrusion process involves passing

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fibrous material through a resin bath and pulling the resulting composite through a die wherein the material is formed into the desired shape and cured.

5 The composite material used to produce the
pultruded components includes a resin binder material,
such as polyester resin which is sold by Owens-Corning
as Model No. E606-6-12. Other suitable resins include,
for example, various polyesters, polypropylenes,
phenolics, epoxies, and polycarbonites. The composite
10 material also preferably includes a multi-directional
array of filamentary material dispersed throughout the
cross-section of the pultrusion. A suitable
filamentary material is known in the industry as 113E-
glass roving. Possible filamentary material
15 substitutes include, for example, glass fibers known in
the industry as E-, S-, S2- and A-glass fibers, as well
as carbon, graphite, boron, and aramid fibers. If
desired, the different filamentary materials can be
mixed in the same part to customize the structural
20 characteristics of that part to its particular
application.

 The container 10 also comprises walls mounted on
the frame 12. Those walls include opposite side walls
50 (only one of which is shown, the other being a
25 mirror image thereof) which each incorporate one of the
upper rails 38 and one of the lower rails 40. Each of
the side walls 50 also includes (Fig. 1) an elongated
sheet-like side panel 52 that is mounted on the
frame 12. More particularly, each side wall 50
30 includes a suitable number of side panel sections or
skins 54 that are each preferably pultruded of the
aforementioned composite materials. Referring to
Fig. 4, the side skins 54 are arranged side-by-side in
coplanar and contiguous relation and are closely spaced
35 or abut one another, and adjacent pairs of the side
skins 54 are bonded together via a joining member or
splice plate 56 and adhesive material 58 to form a
joint 59 therebetween. An example of a suitable

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adhesive material is a methacrylate adhesive sold by ITW Adhesive Systems of Farmington Hills, Michigan under the model designation A0420.

Referring to Fig. 3, to mount the side panel 52 of a side wall 50 on the upper and lower rails 38 and 40 thereof the upper ends of the side skins 54 are adhesively bonded to the inwardly facing surface 44 of the upper rail 38. The lower ends of the side skins 54 are also secured to the lower rail 40, preferably with adhesive material 58. The use of adhesive material 58 provides sealed joints between the side skins 54 and the upper and lower rails 38 and 40.

To stiffen the side panel 52 of each side wall 50 against vertically applied tensile and compressive loads, regularly spaced, vertically extending side wall posts or stiffeners 60 are provided on the side skins 54. While the stiffeners 60 could be made of metallic material, in the arrangement illustrated in the drawings the stiffeners 60 are pultruded of composite material including E-glass fibers. Each of the stiffeners 60 includes a hat portion 62 having a crown 64 with a thickened cross-section to reinforce the stiffener 60 and flange portions 66. If desired, carbon or other fibers can be used in pultruding the stiffeners 60 to supplement or replace the E-glass fibers in the crown 64 to further strengthen the stiffener 60.

While the stiffeners 60 could be attached to the side skins 54 using various mechanical means, such as fasteners (not shown) for example, in a preferred arrangement the stiffeners 60 are bonded to the exterior sides of the side skins 54 with adhesive material 58. As shown in Fig. 3, a section of the hat portion 62 at the top of each stiffener 60 is removed so that the flange portions 66 can extend upwardly over the recessed surface portion 45 of the upper rail 38 and be adhesively bonded thereto.

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As shown in Fig. 4, intermittent ones of the stiffeners 60 are positioned in straddling relation over the joints 59 between the side skins 54. This provides an additional seal and added protection to the joints between the side skins 54. Also, with that arrangement a damaged stiffener 60 over the joint between side skins 54 will fail independently of the joint so that the joint maintains its integrity.

To reduce the occurrence or extent of damage to the stiffeners 60 resulting from catching the stiffeners 60 on an obstruction, such as can occur when maneuvering the container 10 in close quarters with other containers for example, the hat portions 62 of the stiffeners 60 are generally trapezoidally-shaped. This configuration encourages obstructions to glance off the stiffeners 60 or to at least avoid becoming hung-up on the stiffeners 60 and ripping the stiffeners 60 from the side walls 50.

In the event of damage to one of the stiffeners 60, the damaged stiffener 60 can be easily and quickly repaired with a patch member 70 (Figs. 3 and 4). The patch member 70 is configured to fit over a damaged one of the stiffeners 60 and includes an inner surface 72 that corresponds to the outer surface of the stiffener 60. The patch member 70 is adhesively bonded over the damaged stiffener 60 and can be cut to any desired length depending upon the extent of the damage. As shown in Fig. 4, the patch member 70 is sized to fit over a stiffener 60 so that the crown of the patch member 70 does not extend outwardly beyond the outer margins of the upper and lower rails 38 and 40. Thus, the patch member 70 will not increase the overall outside width of the container 10.

Illustrated in Figs. 5 and 6 is a second embodiment of the arrangement illustrated in Fig. 4. The second embodiment includes modified side skins 74 each having an inwardly offset portion 76 that overlaps the interior side of an adjacent side skin 74 so that

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the exterior surfaces of the side skins 74 form a substantially planar and continuous surface. Overlapping side skins 74 are bonded to one another with adhesive material 58 to form (Fig. 5) sealed seams or lap joints 78 therebetween.

5 The second embodiment illustrated in Figs. 5 and 6 also includes modified stiffeners 80 that each include a vertical post or rib member 82 having integral mounting flanges or feet 84. The stiffeners 80 are
10 attached to the exterior sides of side skins 74 by bonding the feet 84 of the stiffeners thereto with (Fig. 6) adhesive material 58. The stiffeners 80 are preferably arranged so that each lap joint 78 is straddled by a stiffener 80. The rib member 82 of each
15 stiffener 80 also includes a crown 86, an inner surface 88, and an outer surface 90 having arcuate outer surface portions 92 and 94, and a somewhat flattened outermost portion 96 at the crown 86. The surface portions 92, 94 and 96 combine to give the
20 outer surface 90 of the rib member 80 a rounded contour, and more particularly a generally parabolic shape when viewed in cross-section.

Means are provided on each rib member 82 for defining a vertically extending socket or pocket 98
25 along the inner surface 88 thereof. While various pocket defining means can be employed, in the illustrated arrangement such means includes (Fig. 6) a pair of projections 100. The outermost end portions of the projections 100 form lips 102 for holding an insert member in the pocket 98, as is further explained below.
30

In the embodiment illustrated in Figs. 5 and 6, each of the rib members 82 is made of a thermoplastic polymer material which is elastically deformable when engaged by an object. The thermoplastic polymer
35 material is not as strong as the bonds formed by the adhesive material 58 or the fiber-reinforced plastic composite material used to make the side skins 74. Thus, the rib member 82 will fail before those bonds or

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the side skins 74 so that the weathertightness of the container envelope is maintained despite damage to one or more stiffeners 80.

Each of the side wall stiffeners 80 also includes means for reinforcing its rib member 82. In the illustrated arrangement the means for reinforcing the rib member 82 reinforces the crown 86 of the rib member and includes (Figs. 5 and 6) a reinforcing insert or member 104 that is insertable into the pocket 98. The insert member 104 is held in place against the inner surface 88 of the corresponding rib member 82 by the projections 100. If desired, the reinforcing member 104 can be adhesively bonded to inner surface 88 with adhesive 58 (see Fig. 6).

While the reinforcing member 104 can be variously configured, in the illustrated arrangement the reinforcing member 104 is a rectangular plank which is pultruded of the aforementioned fiber-reinforced plastic composite material. To further stiffen the reinforcing member 104, carbon or other fibers can be added to the E-glass fibers or can replace the E-glass entirely, as desired.

To insert the reinforcing member 104 into a corresponding rib member 82, the outer surface portion 96 of the rib member 82 is pressed inwardly (Fig. 7) so that the projections 100 are drawn away from one another a distance sufficient to permit the reinforcing member 104 to be fitted into the pocket 98. Thereafter, the outer surface portion 96 is released so that it snaps back to its original position. In that position, the projections 100 tightly grasp and confine the reinforcing member 104 within the pocket 98.

While in the embodiment shown in Figs. 5 and 6 the rib member 82 is provided with a pocket 98, in other embodiments (see Fig. 8) the pocket 98 can be eliminated and the reinforcing member 104 can be mounted on the rib member by adhesive material 58 only.

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Illustrated in Fig. 9 is a stiffener 106 which is a modified version of the stiffeners 60 illustrated in Figs. 3 and 4. Fig. 9 also shows the stiffener 106 overlaying a modified lap joint 78' formed by an outwardly offset portion 76' that replaces the inwardly offset portion 76 (Fig. 3). By replacing lap joints 78 with lap joints 78' the side walls are provided with smooth interior surfaces.

The walls also include (Fig. 1) a front wall 110. The front wall 110 includes overlapping front skins 112 that are adhesively bonded to one another to form a sheet-like front panel similar to side panel 52. The front wall 110 is also provided with front wall stiffeners 114 to reinforce the front skins 112. Referring to Fig. 10 which shows half-sections of alternative front wall stiffener constructions, each front wall stiffener 114 can be constructed as a one-piece pultruded member (see left half of Fig. 10) similar to side wall stiffeners 60 and 106. Alternatively, each front wall stiffener 114 can be constructed as a two-piece member (see right half of Fig. 10) including a rib member 116 and a reinforcing member 118. If the front wall stiffeners 114 are two-piece members they are assembled as described above with respect to side wall stiffeners 60 (see Figs. 7 and 8).

The walls also include (Fig. 1) a top wall 120 which incorporates the upper fittings 22 and 34. The top wall 120 includes sheet-like roof panel including roof skins 122 that are bonded together via adhesive material and a splice plate 124 to form a joint similar to the joint illustrated in Fig. 4 between adjacent side skins 54. In the illustrated arrangement the roof skins 122 and the splice plate 124 are also pultruded of composite material. In other arrangements, the roof could be a single continuous sheet and could be made of other materials such as a thermoplastic material.

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The top wall 120 also includes roof bows 126 (one is partially shown in Fig. 3) for supporting the roof skins 122. The roof bows 126 extend between the upper rails 38 and are similar in design to the front wall stiffeners 114. Referring to Fig. 11 which shows half-sections of alternative roof bow constructions, each roof bow 126 can be a single piece pultruded member (see left half of Fig. 11) or a two-piece member including a rib member 128 and a reinforcing member 130 (see right side of Fig. 11). If the roof bows 126 are two-piece members they are assembled as described above with respect to side wall stiffeners 60 (see Figs. 7 and 8).

The container 10 is also provided with (Fig. 2) a bottom wall 132 that incorporates the lower corner fittings 24 and 36 and that includes regularly spaced apart crossmembers 134 extending between the lower rails 28. The crossmembers 134 support (Fig. 3) a floor 136. The bottom wall 132 also includes a tunnel section 138 for receiving a chassis (not shown) so that the container 10 can be transported over the road.

Advantageously, walls 50, 110 and 120 are constructed of lightweight, non-metallic overlapping skins that are sealed at their joints, and the alternative side wall stiffeners 60, 80 and 106, the front wall stiffeners 114, and the roof bows 126 are adhesively bonded to their associated walls to thereby avoid leak problems which can result with the use of fasteners. Additionally, the configurations of the stiffeners 60, 80, 106 and 114 and the use non-metallic materials in those stiffeners renders the walls resistant to damage. If damage should occur, it is localized and tends not to penetrate the sealed envelope of the container 10, and the stiffeners can be easily repaired with a patch member such as patch member 70.

Various features and advantages of the invention are set forth in the following claims.

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CLAIMS

1. A vehicle body comprising
top, bottom, and opposite side walls
interconnected to form a box-like structure, each of
5 said side walls including a plurality of skin members,
said skin members being adhesively bonded to one
another to form a sheet-like side wall panel, and
a plurality of stiffeners for reinforcing said
skin members, said stiffeners being adhesively bonded
10 to said skin members, and each of said stiffeners being
made of a non-metallic material.
2. A vehicle body as set forth in claim 1 wherein
said non-metallic material includes one of a
thermoplastic material and a thermosetting material.
- 15 3. A vehicle body as set forth in Claim 1 wherein
said non-metallic material is a fiber-reinforced
plastic composite material.
4. A vehicle body as set forth in claim 1 wherein
each of said stiffeners includes a vertically extending
20 rib member, said rib member defining a vertically
extending pocket, and a reinforcing member, said
reinforcing member being insertable into said pocket of
said rib member.
5. A vehicle body as set forth in claim 1 wherein
25 each of said stiffeners includes a vertically extending
rib member, said rib member including opposite inner
and outer surfaces, and said rib member being made of a
non-metallic material, and a reinforcing member
supported on said inner surface of said rib, said
30 reinforcing member being made of a non-metallic
material that is different from said non-metallic
material of which said rib member is made.
6. A vehicle body as set forth in claim 1 wherein
each of said skin members overlaps another of said skin
35 members to form a lap joint, and wherein one of said
stiffeners is positioned in straddling relation over
each of said lap joints.

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7. A vehicle body as set forth in claim 1 wherein each of said stiffeners includes an inner surface, and an outer surface having an arcuate outer surface portion.

5 8. A vehicle body as set forth in claim 7 wherein said outer surface of each of said stiffeners is parabolically shaped.

10 9. A vehicle body as set forth in claim 7 wherein said outer surface of each of said stiffeners includes a flattened outer surface portion, and another arcuate surface portion, each of said arcuate surface portions of each of said stiffeners extending from said flattened surface portion thereof toward one of said side walls, and said arcuate surface portions and said
15 flattened outer surface portion of each of said stiffeners combining to provide said outer surface thereof with a parabolic shape.

20 10. A vehicle body as set forth in claim 1 wherein each of said skin members is made of a non-metallic material, and wherein each of said side walls includes a plurality of splice plates, each of said splice plates being adhesively bonded to a pair of said skin members to join said pair of skin members.

25 11. A vehicle body as set forth in claim 1 wherein each of said stiffeners includes a crown, and means for reinforcing said crown.

30 12. A vehicle body as set forth in claim 11 wherein said means for reinforcing said crown of each of said stiffeners includes a reinforcing member made of a non-metallic material.

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13. An intermodal container comprising
a top wall including a plurality of lock-receiving
connectors,

5 a bottom wall including a plurality of lock-
receiving connectors, and

opposite side walls extending vertically between
said top and bottom walls, each of said side walls
including a side panel having an interior surface and
an exterior surface, said side panel being made of a
10 non-metallic material, and a plurality of stiffeners,
each of said stiffeners being adhesively bonded to said
exterior surface of said side panel.

14. An intermodal container as set forth in claim
13 wherein each of said stiffeners includes a
15 vertically extending rib member, said rib member
including an outer surface which is parabolically
shaped when viewed in cross-section taken along a
horizontal plane.

15. An intermodal container as set forth in claim
20 13 wherein each of said stiffeners is made of a non-
metallic material.

16. An intermodal container as set forth in claim
15 wherein each of said stiffeners includes a
vertically extending rib member, said rib member of
25 each of said stiffeners being made of a thermoplastic
material.

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17. An intermodal container as set forth in claim 13 wherein each of said stiffeners includes a vertically extending rib member, said rib member including an inner surface, and a reinforcing member supported on said inner surface of said rib member, said reinforcing member being made of a fiber-reinforced plastic composite material.

18. An intermodal container as set forth in claim 17 wherein said rib member of each of said stiffeners includes a pair of opposed projections extending from said inner surface thereof, said projections defining therebetween a vertically extending interior pocket, and wherein said reinforcing member of each of said stiffeners is insertable into said interior pocket thereof.

19. An intermodal container as set forth in claim 13 wherein each of said stiffeners includes a rib member, said rib member being made of a first non-metallic material, and a reinforcing member supported on said rib member, said reinforcing member being made of a second non-metallic material different from said first non-metallic material.

20. A vehicle body comprising
a top wall,
a bottom wall,
a pair of side walls interconnecting said top and bottom walls to form a box-like structure, each of said side walls including an upper rail made of a non-metallic material, a lower rail made of a non-metallic material, a plurality of sheet-like panel members adhesively bonded together to form a side panel, each of said sheet-like panel members being made of a non-metallic material, said side panel being adhesively bonded to said upper and lower rails, and a plurality of vertical stiffeners adhesively bonded to said sheet-like panel members to reinforce said side panel, each of said stiffeners being made of a non-metallic material.

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21. A vehicle body as set forth in claim 20 wherein each of said sheet-like panel members overlaps another of said sheet-like panel members to form a lap joint therebetween, and wherein one of said stiffeners is positioned in straddling relation over each of said lap joints formed between said sheet-like panel members.

22. A vehicle body as set forth in claim 20 wherein said sheet-like panel members are aligned side-by-side in contiguous abutting relation, and wherein each of said side walls includes a plurality of splice plates made of a non-metallic material, each of the splice plates being adhesively bonded over an abutting pair of said sheet-like panel members to form a splice joint between said abutting pair of said sheet-like panel members.

23. A vehicle body as set forth in claim 22 wherein one of said stiffeners is positioned in straddling relation over each of said splice joints formed between said sheet-like panel members.

24. A vehicle body as set forth in claim 20 wherein said upper rail of each of said side walls includes an inwardly facing surface, said side panel of each of said side walls being adhesively bonded to said inwardly facing surface of said upper rail thereof, wherein said inwardly facing surface of each of said upper rails includes a recessed surface portion, wherein each of said stiffeners includes a hat portion and flange portions, and wherein the flange portions of each of said stiffeners are adhesively bonded to said recessed surface portion of one of upper rails.

25. A vehicle body as set forth in claim 20 wherein said upper rail of each of said side walls includes an inwardly extending flange, and wherein said top wall includes a plurality of roof bows made of non-metallic material, said roof bows extending between and being supported by said inwardly directed flanges of said upper rails, and a roof panel, said roof panel

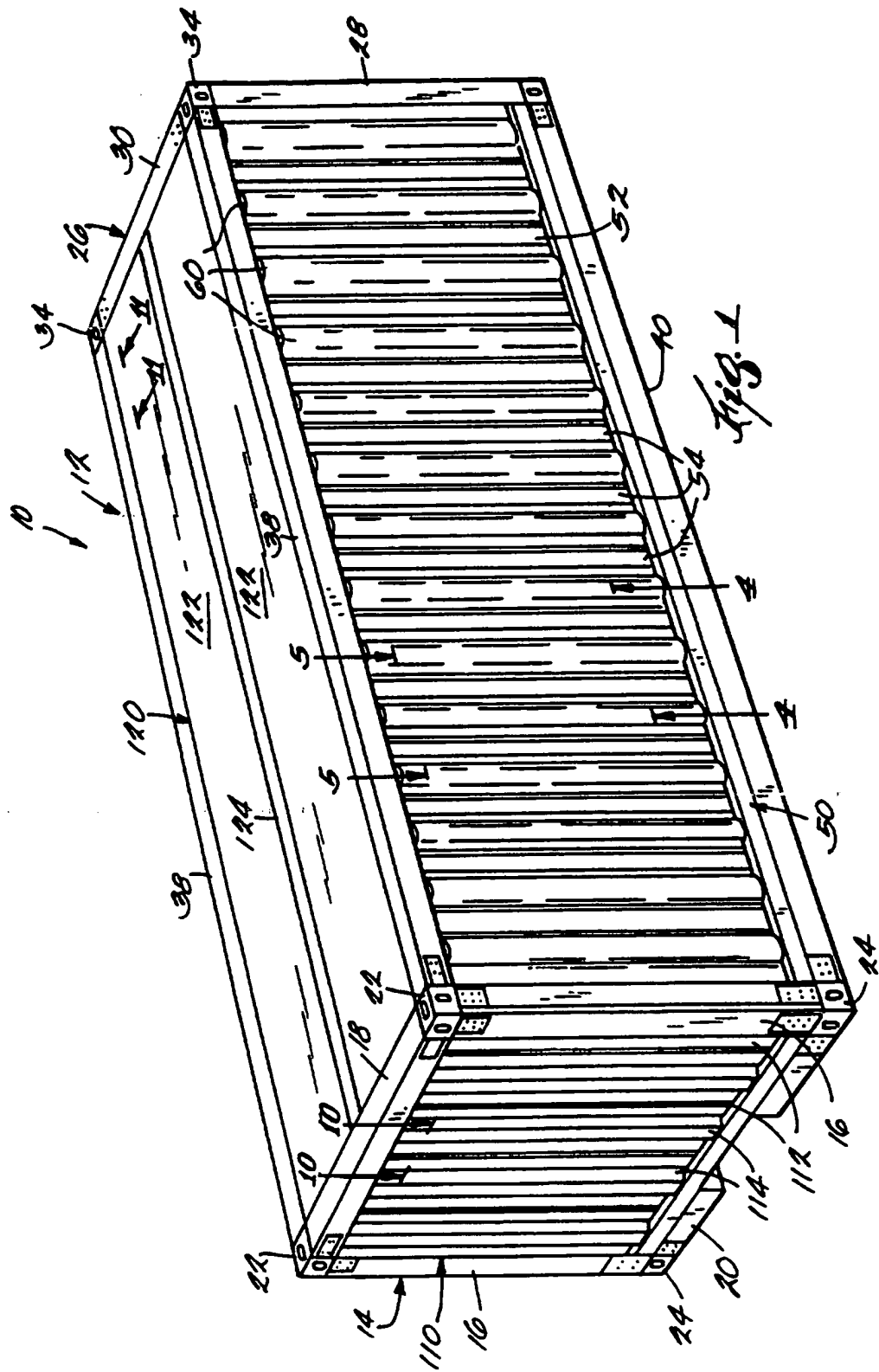
-19-

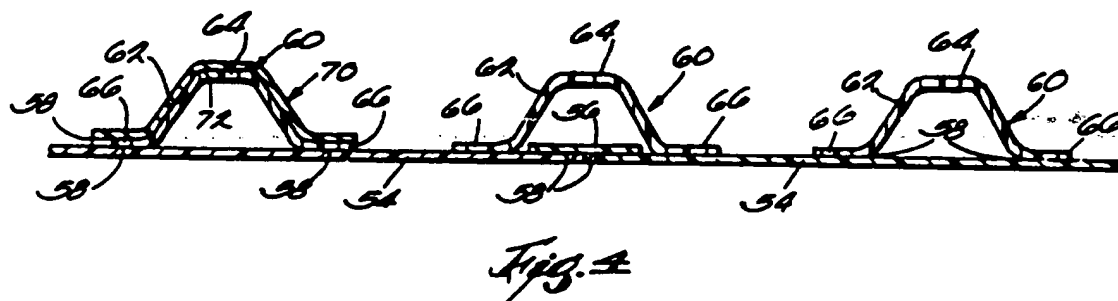
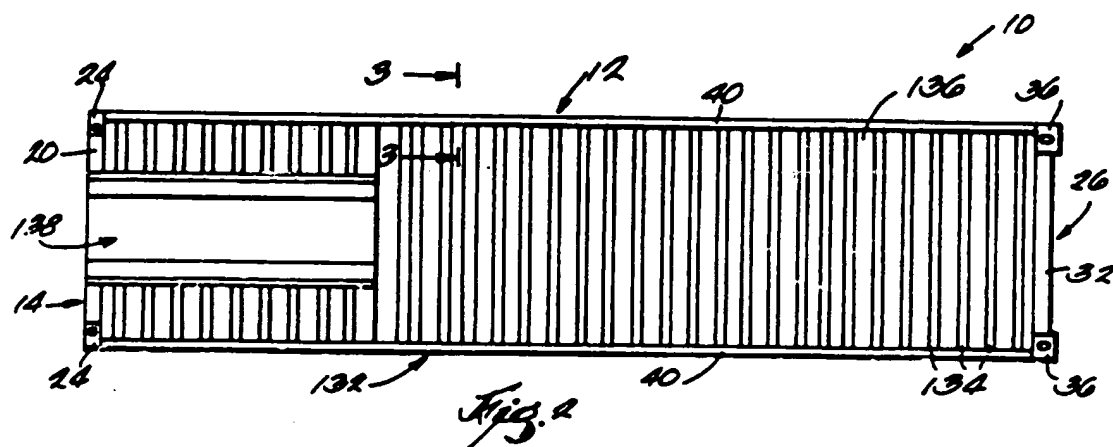
including abutting sheet-like roof skins, each of said roof skins overlapping one of said upper rails and being adhesively bonded thereto.

26. A vehicle body as set forth in claim 20
5 wherein said lower rail of each of said side walls is Z-shaped and includes an inwardly extending upper flange, and an outwardly extending lower flange, said outwardly extending lower flange extending outwardly beyond said stiffeners.

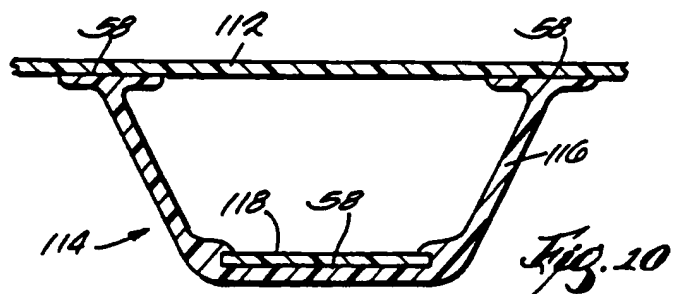
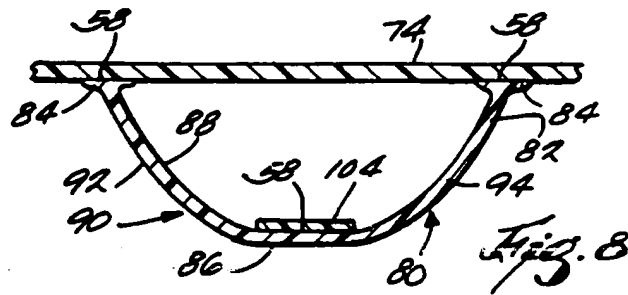
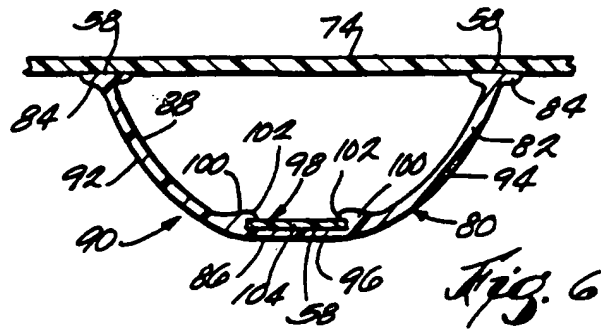
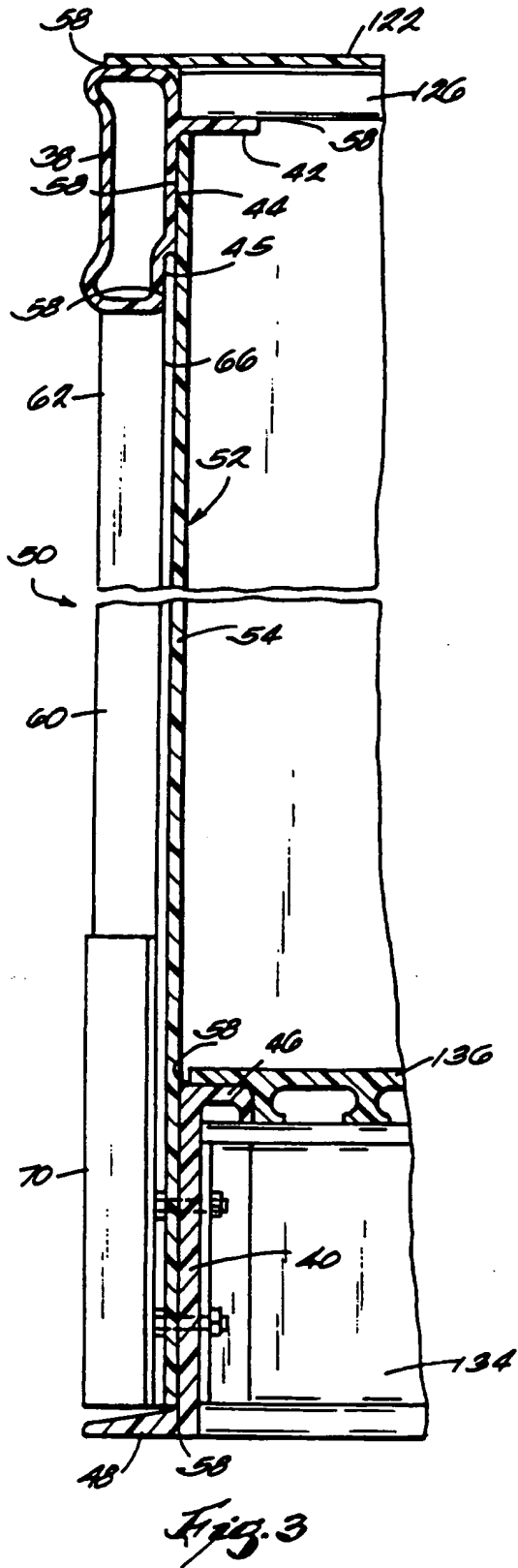
10 27. A vehicle body as set forth in claim 26 wherein said bottom wall includes a plurality of crossmembers extending between said lower rails of said side walls, and floor section supported on said crossmembers, said floor section overlapping said upper
15 flanges of said lower rails.

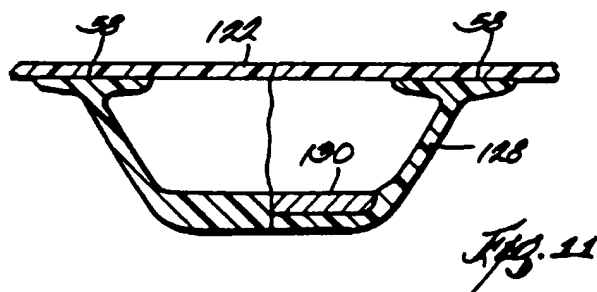
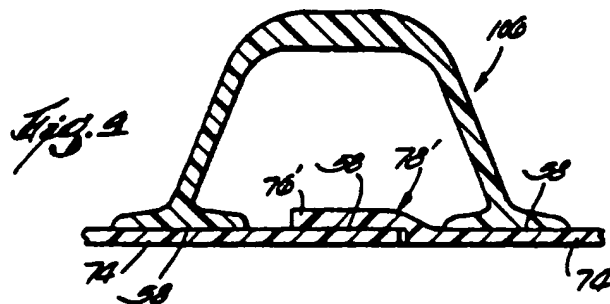
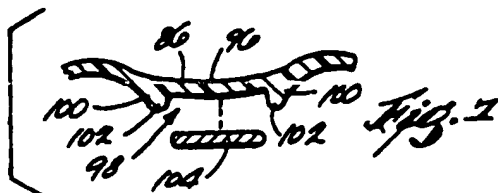
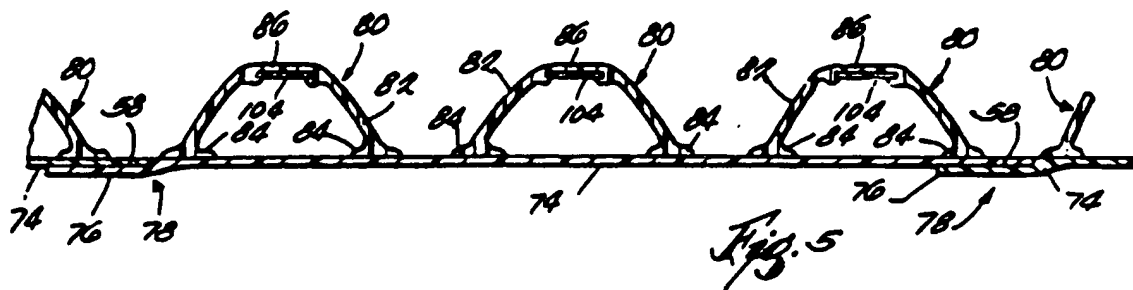
28. A vehicle body as set forth in claim 20
wherein said vehicle body includes an exterior overall width, wherein said vehicle body includes a patch
20 member adhesively bonded over one of said stiffeners so that the exterior overall width of said vehicle body is unchanged thereby, said patch member reinforcing said one stiffener, and said one stiffener including an
outer surface and said patch member including an inner
25 surface corresponding to said outer surface of said one stiffener.





SUBSTITUTE SHEET (RULE 26)





SUBSTITUTE SHEET (RULE 26)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/03898**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) :B62D 29/04

US CL :296/181, 183, 187, 191, 901; 220/1.5, 670, 679, 680; 52/79.1

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 296/181, 183, 187, 191, 901; 220/1.5, 669, 670, 671, 678, 679, 680; 52/79.1, 274, 630, 784.14, 793.11

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X, P	US, A, 5,403,062 (SJOSTEDT ET AL.) 04 APRIL 1995 See entire document.	1-3, 6, 11-13, 15, 16, 20, 21, 25
X ---- Y	US, A, 3,561,633 (MORRISON ET AL.) 09 FEBRUARY 1971 See entire document.	13 ----- 1-5, 7, 10-12, 15-17, 19; 20, 22, 23, 25, 28; 20, 22, 23, 25, 28; 6, 21, 24, 26, 27

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	*T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
A document defining the general state of the art which is not considered to be of particular relevance	*X*	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
E earlier document published on or after the international filing date	*Y*	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G*	document member of the same patent family
O document referring to an oral disclosure, use, exhibition or other means		
P document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

21 JUNE 1996

Date of mailing of the international search report

17 JUL 1996

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INTERNATIONAL SEARCH REPORT

 International application No.
 PCT/US96/03898

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 5,255,806 (KORZENIOWSKI ET AL.) 26 OCTOBER 1993 See entire document.	1-5, 7, 10-12, 15-17, 19; 1-5, 7, 10-13, 15-17, 19; 20, 22, 23, 25, 28; 20, 22, 23, 25, 28; 6, 21, 24, 26, 27
Y — A	US, A, 4,444,818 (TOMINAGA ET AL.) 24 APRIL 1984 See entire document.	1-5, 7, 10-12, 15-17, 19; 1-5, 7, 10-13, 15-17, 19; 20, 22, 23, 25, 28; 20, 22, 23, 25, 28; 6, 21, 24, 26, 27 ----- 8, 9, 14
Y	US, A, 4,904,017 (EHRlich) 27 FEBRUARY 1990 See entire document, especially Fig. 5.	6, 21, 24, 26, 27

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/03898

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-17 and 19-28

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/03898

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING

This ISA found multiple inventions as follows:

This application contains claims directed to more than one species of the generic invention. These species are deemed to lack Unity of Invention because they are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for more than one species to be examined, the appropriate additional examination fees must be paid. The species are as follows:

Species I: Figure 8; and

Species II: Figure 10.

The claims are deemed to correspond to the species listed above in the following manner:

Species I: Claims 8, 9, and 14; and

Species II: Claim 18.

The following claims are generic: claims 1, 2, 11-13, 15, 16, 20, and 25-27.

The following claims are deemed to not lack Unity of Invention under PCT Rule 13.1 with either I or II above: claims 1-7, 10-13, 15-17, and 19-28.

The species listed above do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, the species lack the same or corresponding special technical features for the following reasons:

Species I: the special technical feature of the outer surface of each stiffener being parabolically shaped; and

Species II: the special technical feature of the rib member of each stiffener including a pair of opposed projections extending from the inner surfaces thereof, the projections defining therebetween a vertically extending interior pocket in which the respective reinforcing member of the stiffener thereof is insertable.